

# Placement and management of vascular access catheters

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# Overview

- **Significance and magnitude of complications**
- **Technical aspects of placement**
- **Preventative strategies**
- **Practical cases**

# General

- **20 million patient's receive vascular catheters per year**
- **3 million central venous catheters/yr**
- **Catheter associated sepsis frequency: 4-14% estimated 120,000 cases of line sepsis/yr**
- **Line sepsis increases mortality, morbidity and duration of hospitalization**

# Complications of central venous catheters

- **Placement**
  - **Hemorrhage, hematoma, hemothorax**
  - **Pneumothorax**
  - **Air embolism**
  - **Cardiac dysrhythmia**
  - **Arterial puncture**
  - **Nerve injury**
  - **Thrombus dislodgment**
  - **Pericardial tamponade**
  - **IVC filter entanglement**
  - **Chylothorax**
  - **Interstitial, mediastinal or intrapleural position**

# **General insertion recommendations**

- **Larger prep is better, more prep is better**
- **Full sterile garb please**
- **Full sterile drape**
- **Be comfortable- eat and empty bladder, if time permits**
- **Position the bed for maximal efficiency and comfort**
- **Don't even think about sticking that patient till you're sure about the anatomy**

# General insertion recommendations

## continued

- The wire will touch any exposed non-sterile surfaces
- Terminate the procedure if sterility is violated
- Communicate with the patient, reassurance is the best anxiolytic,
- Be liberal with lidocaine, anxiolytics if ventilated.
- Move to another site if no success with 3-5 passes
- 10cm of wire in the vessel is plenty. Avoid passing the wire into the heart
- If the wire doesn't pass, the needle and wire should be removed together, or risk shearing or unraveling the wire.

# Internal Jugular Vein

## - Pros

- Compressible
- Facilitates PA catheter placement

## - Cons

- Risk of pneumothorax
- Carotid artery puncture
- Challenging landmarks in the obese
- Often not accessible, C-collars, trach
- Possible increased infection risk (pulmonary secretions)
- Left sided IJ - increased risk of PTX and thoracic duct injury

# Internal Jugular Vein

- **Positioning**

- Trendelenberg position
  - Head rotated contralateral to insertion site

- **Preparation**

- Liberal use of prep - iodine or chlorhexidine, in circular pattern - encompass angle of jaw, suprasternal notch
  - Allow prep to dry before insertion
  - Consider prepping ipsilateral subclavian at same time.

- **Tips**

- This is a superficial vessel, should easily be found with finder needle. There is NEVER a need to hub the large needle!!

# Subclavian Vein

## – Pros:

- Reliable landmarks and position
- ACLS - placement does not interfere with airway management
- When fresh tracheostomy or c-collar in place
- Possible lower infection risk?

## – Cons:

- Noncompressible - avoid in coagulopathy
- Risk of pneumothorax- especially with bullae
- Risk of post-procedure stenosis - problematic in dialysis patients

# Subclavian Vein

- **Positioning**

- Trendelenberg 15 degrees or more
- Back roll optional
- Head either midline or deviated to contralateral side
- Displace ipsilateral arm downward, an assistant applying traction can help in difficult cases

- **Tips**

- Rotate the bevel inferiorly before passing the wire
- Needle should always remain parallel to chest, NEVER “dive” under the clavicle, depress the shoulder and chest tissue
- Hit the clavicle, then walk under it

# Femoral Vein

## – Pros

- Ease of placement
- Compressible
- No risk of pneumothorax
- Ideal if Trendelenburg position is not tolerated or contraindicated

## – Cons

- Increased risk of thrombosis
- Possible increased risk of infection
- Challenging PA catheter flotation
- Potential for retroperitoneal hemorrhage, stay below inguinal ligament!
- Decreased patient mobility

# Femoral Vein

- **Preparation**
  - Shaving recommended by most
  - Vigorous cleaning/scrub site
- **Positioning**
  - Reverse trendelenberg
  - Assistant applying pannus traction
  - External rotation of leg optional
- **Tips:**
  - Push hard to find the pulse
  - Ask...Does this patient have a IVC filter?

# Arterial line placement

- **Radial artery**
- **Femoral artery**
- **Dorsalis pedis artery**
- **Axillary artery**
  
- **Note - the brachial artery is an end artery - cannulation can lead to arm ischemia and should be avoided.**

# Arterial line placement

## Indications

- **Hemodynamic monitoring**
  - titration of vasopressors
  - management of hypertensive emergencies
  - BP confirmation when unreliable noninvasive readings
  - monitoring when hemodynamic instability is likely
- **Frequent arterial blood gas sampling**

# Line Sepsis

- The dreaded complication of central venous access.
- What are the risk factors?
- How can we reduce the risk?

# **Catheter colonization, mechanisms**

- Skin insertion site - most common
- Hub colonization
- Hematogenous seeding
- Contaminated infusate

# **Prevention of line sepsis**

- **Must prevent colonization at one of three points**
  - **time of insertion**
  - **post insertion skin flora changes**
  - **post insertion utilization of catheter**

# Insertion precautions

- How important is aseptic technique?

- **Maximal sterile technique - four fold reduction in PA catheter infection and introducer colonization**

*McCormick, abstract Am Soc for Microbiology 1989*

- **Skin preparation - chlorhexidine possibly superior to povidone-iodine.**

*Maki, Lancet 1991*

- **Infusion therapy teams for insertion and management - can reduce risk of line sepsis 5-8X**

*Faubion, JPEN 1986*

- **Value of protective isolation in ICU**
  - **Pediatric ICU**
    - Children randomized to: health care provider use of gloves, and gowns during care vs standard practices
  - **Results:**
    - reduction in nosocomial infection 2 vs 12 p.01
    - interval to first infection - 20 vs 8 days p=.04
    - time to colonization 12 vs 7 days p=.01
    - daily infection rate 2.2 times lower p=.007
    - days febrile 13% vs 21% p=.001

# **Risk of catheter infection**

- **Daily risk of infection**
  - Peripheral iv: 1.3%/day
  - Peripheral arterial catheter: 1.9%/day
  - Central venous catheter: 3.3%/day
- **Risk of infection per day appears to be more linear than logarithmic**

# Risk Factors for infection

- Prolonged catheterization
- Frequent manipulation
- Transparent plastic dressings
- Contaminated skin solutions
- Improper aseptic techniques
- Catheter material
- Number of catheter lumens
- Location of catheter

- **Host factors**
  - antibiotic therapy
  - corticosteroid therapy
  - Illness severity
  - immunosuppression

# Protective factors

Insertion/maintenance by infusion team

Maximal aseptic technique

Topical disinfectants and antibiotics

silver impregnated cuff

antibiotic impregnated catheters

# **Skin Care**

- **Povidone-iodine gel does not prevent line infections**
- **Entry site abx's decrease bacterial line sepsis, but increase fungal line sepsis, ex. Bacitracin, bactroban etc.**
- **Plastic dressings may increase infection risk by enhancing bacterial growth**
- **Skin flora and density of organisms predicts risk for line infection**

# Frequency of Line changes

- **Data is equivocal however most recent data recommend clinical judgement over scheduled catheter change**
- **The “right” answer may depend on each institution’s experience with line change policy**
- **Risk of technical complications from line replacement has to be balanced with risk of line infection**

# Guide-wire Changes

- **Guide-wire exchanges- no randomized prospective data supporting efficacy in reducing line sepsis**
- **Guide-wire changes probably do not increase infection risk, and do carry less risk of procedural complications than new line placement**
- **Sheep model suggested showering of bacteria with guide-wire change and cross contamination of the new line**

# Reference

- **Guideline for Prevention of Intravascular Device-Related Infections. Am J Infect Control 1996;24:262-293**